TOUCH SENSOR

FIELD OF THE INVENTION

[0001] The present invention is directed generally to a touch sensor, and more particularly to a durable, transparent touch sensor.

BACKGROUND

[0002] Touch sensors are increasingly popular devices because they provide a natural interface between an electronic system and operator. Rather than using a keyboard to type in data, for example, touch sensors allow the user to transfer information to a computer by touching a displayed icon, or by writing or drawing on a screen. It is desirable in many applications for the touch screen to be transparent and positioned over a display.

[0003] Several types of transparent touch sensors use resistive or capacitive techniques to detect touch location. A resistive touch sensor includes two layers of transparent conductive material, such as a transparent conductive oxide, separated by a gap. When touched with sufficient force, one of the conductive layers flexes to make contact with the other conductive layer. The location of the contact point is detectable by controller circuitry that senses the change in resistance at the contact point.

[0004] Resistive touch sensors depend upon actual contact between the conductive layers, and this technique presents several problems. First, frequent contact causes the conductive layers to rub and may damage the conductive layers. Transparent conductive layers are brittle and flexing causes degradation in the conductive material due to microcracks at the flex point. With repeated flexing, an area of conductive material may flake off from one contact, thereby causing voids in the contact layers. Also, the conductive layer used in a resistive touch sensor may degrade due to interaction between the conductive layers and surrounding materials. Degradation of the conductive layers by the mechanisms discussed above may result in decreased optical transmission or loss of sensitivity, resolution, and accuracy in detecting the touch location.

[0005] A capacitive touch sensor typically includes a single conductive layer for touch detection. A finger touch to the sensor provides a capacitively coupled path from the conductive layer through the body to earth ground. The location of the contact point is detectable by controller circuitry that measures a change in a capacitively coupled electrical signal at the touch location.

[0006] In contrast to the resistive touch sensor, operation of the capacitive touch sensor described above does not require flexing a conductive layer to the point of contact. However, the capacitive sensor requires a more complex controller to compensate for low signal to noise ratio due to large external capacitance and the variability of the capacitance of the finger touch. A capacitive touch sensor requires that the touch produce a capacitively coupled circuit to ground and is only operable by a finger touch or a conductive stylus. Touches with a non-conductive stylus, gloved hand or fingernail are typically undetectable, or are undetectable under most circumstances. Further, operating a sensor by a finger touch may not provide the spatial resolution required for some applications, for example, drawing on a small hand held computer screen. Spatial resolution may be improved using a conductive stylus, however, some users find the requirement of a special stylus objectionable.

SUMMARY OF THE INVENTION

[0007] Generally, the present invention relates to a method and system for detecting the location of a touch on a touch sensor. The present invention is particularly useful when combined with a microprocessor-based system operating a display device enhanced by a transparent touch screen. More particularly, the invention is directed to a touch sensor in which the approach of a conductive layer towards another conductive layer is capacitively sensed.

[0008] In accordance with one embodiment of the present invention, a method for sensing a two-dimensional location of a touch on a touch sensor includes sensing a change in capacitance between a first transparent, conductive sheet and a second transparent, conductive sheet when at least a portion of the first transparent, conductive sheet is moved towards the second transparent, conductive sheet. The two-dimensional location of the touch is determined from signals derived from the change in capacitance between the two transparent conductive sheets.

[0009] Another embodiment of the invention is directed to a touch sensor that has a first transparent, conductive sheet supported on a flexible, transparent supporting layer. A second transparent, conductive sheet disposed to define a gap between the first and second transparent, conductive sheets. The first transparent, conductive sheet is flexible to allow local deformation towards the second transparent, conductive sheet due to a touch force without contacting the second transparent, conductive sheet so as to produce a change in capacitance between the first and second transparent, conductive sheets.

[0010] Another embodiment of the invention is directed to a touch sensor that has a first conductive layer, the first conductive layer being transparent and flexible. A second conductive layer is transparent and is disposed relative to the first conductive layer to define a gap between the first and second conductive layers. The first transparent, conductive layer is flexible to allow local deformation towards the second transparent, conductive layer due to a touch force without contacting the second transparent, conductive layer so as to produce a change in capacitance between the first and second transparent, conductive layers. A plurality of spacers is located within the gap. The spacers are transparent and permit movement of the first conductive layer towards the second conductive layer under a touch while maintaining a predetermined minimum distance between the first and second conductive layers.

[0011] Another embodiment of the invention is directed to a touch screen display system that has a touch screen for sensing a touch. The touch screen includes a first transparent, conductive sheet supported on a flexible, transparent supporting layer. A second transparent, conductive sheet is disposed relative to the first transparent, conductive layer and defines a gap therebetween. The first transparent, conductive sheet is flexible to allow local deformation towards the second transparent, conductive sheet due to a touch force without contacting the second transparent, conductive sheet so as to produce a change in capacitance between the first and second transparent, conductive sheets. A touch screen